國立臺北科技大學九十八學年度碩士班招生考試

系所組別：1112 機電整合研究所甲組

第二節　自動控制（選考）試題

注意事項：

1. 本試題共五題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. 20% The transfer function of a system is shown in Figure 1 and its root locus with varying K is shown in Figure 2. The root locus starts from 0, -10, $-2 \pm j2$ and K=40.4 at the breakpoint on the real axis.

(A) Determine the transfer function $G(s)$. 7%

(B) Determine the maximum K while the closed-loop system is stable. 6%

(C) Determine the gain margin and phase margin of this system if K=1. 7%

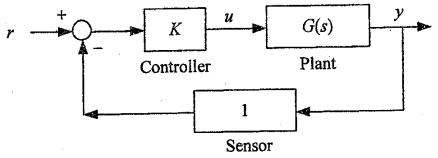

Figure 1

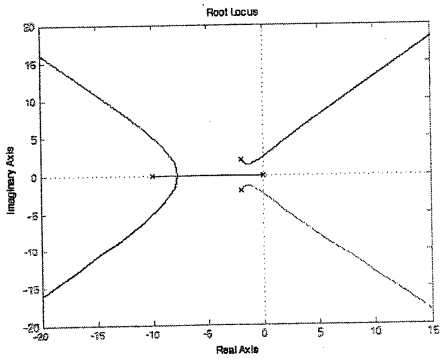

Figure 2

2. 20% A system shown in Figure 3 is required to have the following specifications

I. Percentage Overshoot < 10%

II. 2% Settling Time < 3sec

III. Peak Time < 1sec

(A) Draw the permissible area on the s-plane, which satisfies the above requirements. 10%

(B) Determine the value K, p and locations of the poles if the system design has the first priority of minimum damping ratio and the second priority of minimum ω_n. 10%

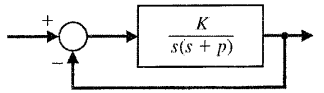

Figure 3

3. 20% Consider the system shown in Figure 4. Design a controller G_c such that the static velocity error constant K_v is 5 sec^{-1}, the phase margin is at least 40°, and the gain margin is at least 10 dB.

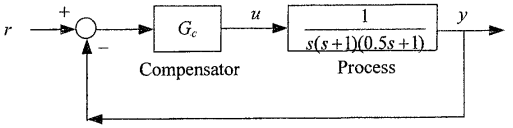

Figure 4

4. 20% Consider a regulator system shown in Figure 5. Two sets of system parameters are considered for the final design.

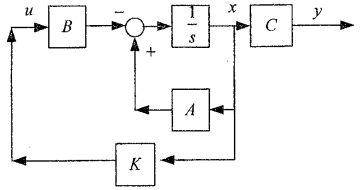

Figure 5

Design 1:

$$A=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -1 & -5 & -6\end{bmatrix} \quad B=\begin{bmatrix}0\\0\\1\end{bmatrix} \quad C=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\end{bmatrix}$$

Design 2:

$$A=\begin{bmatrix}0 & 1 & 0\\ 1 & 0 & 0\\ -1 & -5 & -6\end{bmatrix}\quad B=\begin{bmatrix}0\\0\\1\end{bmatrix}\quad C=\begin{bmatrix}0 & 1 & 0\\ 1 & 0 & 0\end{bmatrix}$$

(A) Determine which design is better and explain your reason. 10%

(B) Determine the state feedback gain K for the design you choose such that the closed-loop system will have desired eigenvalues of $-2 \pm j4$, -10. 10%

5. 20% A linear mass-friction-spring system is constructed as shown in Figure 6 and its dynamic equation can be expressed as

$$\ddot{y}+6\dot{y}+8y=r$$

Determine the displacement function $y(t)$ of mass if the initial conditions of the mass is

$$y(0)=1 \quad \dot{y}(0)=0$$

and the external force $r(t)$ is given as shown in Figure 7.

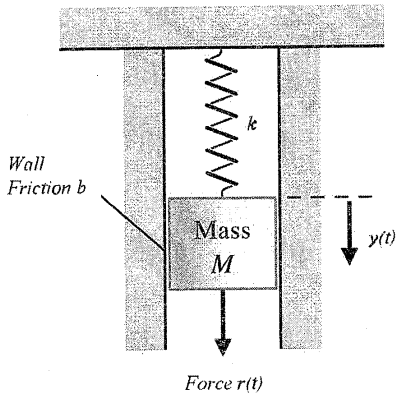

Figure 6

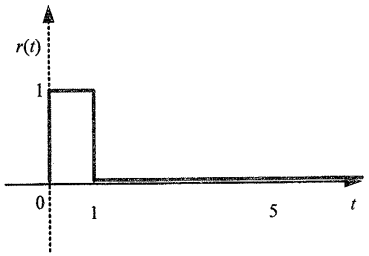

Figure 7